Office of Energy Efficiency and Renewable Energy

Using Non-Thermal Plasma Reactor to Reduce NO_X Emissions from CIDI Engines

Background

Under the Partnership for a New Generation of Vehicles, auto manufacturers are pursuing technologies such as the compression-ignition, direct-injection (CIDI) engine to achieve fuel efficiencies of up to 80 miles per gallon. CIDI engines must meet expected future emissions standards. Current emission control devices such as three-way catalytic converters, are not effective in reducing oxides of nitrogen (NO_X) to levels expected in future emissions standards.

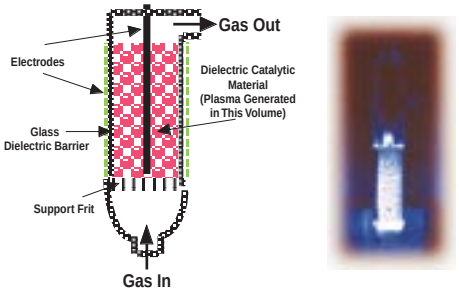
The Office of Advanced Automotive Technologies supports a program that is investigating the effectiveness of an advanced aftertreatment method that employs a non-thermal plasma reactor in conjunction with catalytic materials to reduce NO_X emissions from a diesel-fueled, light-duty CIDI engine. This technology is also applicable to light trucks and sport utility vehicles. The goal of the program is to meet Tier 2-type NO_X emissions standards while using less than 5% of the vehicle's fuel to run the plasma reactor.

Accomplishments

- New catalysts reduced NO_X when placed in or downstream from a plasma reactor. Bench tests with simulated diesel exhaust show that a plasma catalyst system can reduce NO_X emissions by up to 70% at temperatures typical of CIDI exhaust (150–370°C)
- An innovative new plasma reactor design reduced energy consumption in the plasma catalyst system by fivefold.
- A prototype plasma reactor/catalyst system has been fabricated and will be tested in the full exhaust stream of a CIDI engine in.

Benefits

- Allows manufacturers to use fuel-efficient CIDI engines in 80-mpg passenger vehicles and light trucks while meeting emissions standards.



A Dielectric Barrier Packed-Bed Plasma/catalyst Reactor

Future Activities

- Reduce the sensitivity of the catalyst to the type of hydrocarbon present, to maintain high NO_X conversion efficiencies in engine exhaust (current plasma/catalyst systems use unburned hydrocarbons in the exhaust to reduce NO_X).
- Prove feasibility of plasma/catalyst systems under actual operating conditions.
- Evaluate the effects of sulfur and particulates on catalyst activity.
- Transfer technology to emission control manufacturers for evaluation and further development.

Partners in Success

Pacific Northwest National Laboratory
Oak Ridge National Laboratory
Lawrence Livermore National Laboratory
Ford Motor Company
General Motors Corporation
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